CHAIN OF CUSTODY

Teck

Teck Coal Ltd. utilizes a system in which Standard Practices and Procedures are developed, implemented and maintained. This helps ensure that safety and environmental risks associated with various work tasks are identified, mitigated and managed.

1.0 PURPOSE

This document details the procedure to be followed for handling samples during the monitoring event and up to the point of shipping.

2.0 RESPONSIBILITIES

Depending on the operation, field monitoring activities and documentation may be carried out by an Environmental Officer, Environmental Technician (not all operations have this position), or a designate, such as an Environmental Co-op Student.

The Environmental Officer, Technician, or designate is responsible for:

- Proper handling of samples during the monitoring event and prior to shipping.
- Completion of the Chain of Custody form for the analytical laboratory.

3.0 BACKGROUND

Samples need to be collected using specific techniques and appropriately labeled for accurate identification by the laboratory. It is important to ensure appropriate documentation accompanies the sample, and samples reach the laboratory in a timely manner. Therefore, a stringent, established sample labeling and program of sample chain of custody will be followed during sample storage and shipping activities to account for each sample. The procedure outlined herein will be used with the Standard Practices and Procedures documents **TC-GEN-02**, *Field Documentation*, and **TC-GEN-05**, *Sample Storage and Shipment*. This SOP incorporates guidelines from *Protocols Manual for Water Quality Sampling in Canada* (CCME 2011).

A chain-of-custody/analytical request form is necessary for all projects. The form is especially crucial if the project is being carried out for legal reasons (e.g., compliance monitoring). The chain-of-custody record portion of the COC form is the most critical because it documents sample possession from the time of collection through the final disposal of the sample. The analytical request portion of the form

provides information to the laboratory regarding what analyses are to be performed on the samples that are shipped.

A sample is considered to be in a person's custody if any of the following criteria are met:

1. The sample is in the person's possession
2. The sample is in the person's view after being in possession
3. The sample is in the person's possession and is being transferred to a designated secure area
4. The sample has been locked up to prevent tampering after it was in the person's possession.

4.0 PROCEDURES

- Collection of samples must be scheduled to that the timing and logistics of shipping and transport to the laboratory do not compromise the integrity of the samples. For example, if a sample has a two day holding time and the laboratory is closed on weekends, then the sample may need to be collected and shipped very early in the week to avoid having it sit unattended and/or in conditions which may compromise the sample (eg. exposed to cold in the winter or heat in the summer).

- Only authorized personnel are allowed to handle samples.

- Before shipping, always check that all sample bottles recorded on the laboratory chain of custody sheet have been prepared for shipping and are reconciled with what has physically been placed in the cooler or shipping container.

- Laboratory chain of custody forms must be filled out completely, checked over and placed in the cooler with the samples. The forms are sealed in a plastic bag to prevent moisture damage. A copy of the completed chain of custody form is kept in the office (hard copy or electronic). Many samples collected by Teck Coal are for legal reasons (eg. compliance monitoring), and so relevant documentation must be handled with the appropriate consideration.

- Bottles are packed properly and tightly to prevent breakage of glass containers and to avoid spillage. Bubble wrap and/or other packing materials are available in the shipping room. Identification and destination labels are affixed to the shipping cooler or container. Ice packs are included to keep samples as cool as possible during shipping (without freezing samples).

- Samples are shipped via courier and should reach the laboratory within 24 hours. If samples cannot be shipped to arrive at the lab the next day (i.e. too late for courier) they must be refrigerated at the mine site for shipping on the next available courier schedule.

- Samples which are sensitive and/or have short holding times, such as samples of treated potable water for bacteriological analysis, must be sent by courier such that they are received by the Lab within 24 hours. Consider the lab's schedule (ie. if it is closed on weekends).

- Samples to be used for bioassay testing must be received by the laboratory as soon as possible. The time between sample collection and beginning of the test SHOULD be less than 3 days and MUST be less than 5 days. Refer to the Environment Canada documents cited in the "Introduction" section of this document for detailed information.

- The shipping date, waybill number, lab request form control number, laboratory name and the shippers name are recorded in the shipping logbook in the environmental shipping room.

5.0 DEVIATION FROM PROCEDURE

Adherence to this procedure will help to ensure that samples are properly handled following sample collection, are documented properly, and reach the laboratory within acceptable holding time. Deviation from this procedure may result in loss of integrity of the sample.

Include the benefits of ADHERENCE to the procedure, and any risks resulting from DEVIATION from this procedure. This should consider the environment, health & safety, and anything else which is applicable (eg. regulatory considerations, Communities of Interest, etc).

6.0 KEY DOCUMENTS/TOOLS/REFERENCES

- CCME. 2011. Protocols manual for water quality sampling in Canada. PN 1461. Canadian Council of Ministers of the Environment.

- Teck. 2012. Environment, Health, Safety and Community Management Standards. July.

    - Standard 7 – Contractors and Suppliers

- Standard 13 – Monitoring – Measurement, Inspection and Audit
- Standard 20 – Documents and Records

- Environment Canada. 2000. Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout (with May 2007 amendments). EPS 1/RM/13 Second Edition. December.

FIELD DOCUMENTATION AND RECORD KEEPING

Teck

Teck Coal Ltd. utilizes a system in which Standard Practices and Procedures are developed, implemented and maintained. This helps ensure that safety and environmental risks associated with various work tasks are identified, mitigated and managed.

1.0 PURPOSE

Documents and records are required in part to track environmental performance and to demonstrate compliance with legal and other requirements. Field records are necessary in order to document monitoring, measurement and observations, and are a critical component of overall data management.

2.0 RESPONSIBILITIES

Field documentation and record keeping is broadly applicable and not just limited to those who may be performing monitoring or sampling projects in the field. While this applies to monitoring and sampling activities, it is also applicable to inspections which may be required by regulations, other legal requirements, internal corporate requirements, commitments to Communities of Interest, etc.

The scope of this procedure is applicable to environmentally related projects, monitoring, inspections, etc. and applies to anybody working for or on behalf of Teck Coal in an environmental capacity where documentation or record keeping is required.

All persons who have responsibility in collecting records are also responsible in ensuring the safe keeping and storage of those records. Note that electronic records which are stored on a shared drive will have the added protection of being on a system which is backed up each night.

3.0 BACKGROUND

Field documentation and any record keeping may be done for legal purposes (eg. compliance monitoring, inspections required by regulations or other legal requirements); as such, documents and record keeping must be performed with the knowledge that documents and records may be subject to review and scrutiny during audits, inspections and investigations, all of which may be conducted internally or externally. It is possible that records could be looked at months or years following collection. Note that this can include personal note books.

In situations where documents (including forms) are used to assist personnel suitably and consistently perform their assigned tasks for purposes of maintaining control over environment risks and to sustain both environmental performance and compliance with legal and other requirements, the document control processes will be applied to prevent the use of incorrect versions of such documents.

Documentation and record keeping may be done in hard copy or electronic format. Examples of hard copy records include, but aren't necessarily limited to:

- Log books specific to a location (eg. flocculant station) or piece of equipment (eg. hydroseeder)
- Personal log books
- Forms specific to sampling or monitoring projects
- Observation forms (eg. carnivore observations)
- Communities of Interest (COI) interaction forms
- Reporting forms (eg. small spill report forms)
- Inspection records
- Calibration records
- Any other book, booklet, form, etc utilized to document environmentally related information
- Labels on sampling containers
- Laboratory chain of custody forms

- Shipping waybills and records
- Acknowledgement of sample receipt forms

Examples of electronic records include, but aren't necessarily limited to:

- Ruggedized field computers, including tablets using EDGE (EQuIS Data Gathering Engine) software
- Dataloggers (eg. flow monitoring stations, meteorological stations, ambient air stations)
- Photographs and video

Records must be maintained such that they are:

- Identifiable;
- Retrievable;
- Protected against damage or loss; and
- Suitably secured against unauthorized access

Records will be retained for such a time period as to be compliant with applicable regulatory requirements and corporate policies, but there is no intention of disposal of records.

This procedure incorporates guidelines from *Protocols Manual for Water Quality Sampling in Canada* (CCME 2011) and *British Columbia Field Sampling Manual* (British Columbia 2003). It is also in accordance with the Teck EHSC Management Standard for Documents and Records.

4.0 PROCEDURES

Field Records:

Records must be designed such that the sampler and all samples are traceable.

At any location where a measurement or observation is made, and/or a sample is collected, record:

- The name or number of the location. This should match an existing location in the EQuIS database. If not, record details about the site, including GPS coordinates and photograph(s)
- The name(s) of the sampler(s) or observer(s)
- The date
- The time(s) when samples, measurements, or observations are taken
- The result(s) of measurements taken. This should be recorded as soon as the measurement has been taken.
- Any unusual conditions which may interfere with the collection of a sample or with the results of monitoring or sampling

More generally, not necessarily required at each individual sampling location, make note of weather conditions, as this can have a significant impact on environmental conditions measured.

Third Party Forms:

For forms and documents created and used by other parties (eg. Laboratory Chain of Custody forms, shipping waybill forms) there will be some variation depending on the company. It is best practice to fill out forms as completely as possible and to review the record prior to sending out. Lab Chain of Custody forms must include the sampling method (eg. grab, composite, hivol) as well as any preservation, filtration, or other fixing of the sample.

5.0 DEVIATION FROM PROCEDURE

Adherence to this procedure will help to ensure that documents and records are taken and kept in accordance with regulatory and corporate standards. Deviance from this procedure may result in insufficient or substandard documentation of field monitoring activities, missing or loss of information, and/or improper handling of records which can result in weakened data management.

6.0 KEY DOCUMENTS/TOOLS/REFERENCES

- Alberta. 2006. Aquatic ecosystems field sampling protocols. Alberta Environment. March.
- British Columbia. 2003. British Columbia field sampling manual for continuous monitoring and the collection of air, air-emission, water, wastewater, soil, sediment and biological samples. Province of British Columbia, Ministry of Water, Land and Air Protection. January.
- CCME. 2011. Protocols manual for water quality sampling in Canada. PN 1461. Canadian Council of Ministers of the Environment.
- Teck Coal Ltd. 2012. EQuIS Data Management System
- Teck. 2012. Environment, Health, Safety and Community Management Standards. July.
    - Standard 13 – Monitoring – Measurement, Inspection and Audit
    - Standard 20 – Documents and Records

FIELD HOUSEKEEPING AND PREVENTION OF CONTAMINATION

Teck

Teck Coal Ltd. utilizes a system in which Standard Practices and Procedures are developed, implemented and maintained. This helps ensure that safety and environmental risks associated with various work tasks are identified, mitigated and managed.

1.0 PURPOSE

This procedure is intended to ensure good housekeeping practices and to manage, clean and maintain equipment and sampling materials in such a way so as not to contaminate samples or results.

2.0 RESPONSIBILITIES

Depending on the operation, field monitoring activities and documentation may be carried out by an Environmental Officer, Environmental Technician (not all operations have this position), or a designate, such as an Environmental Co-op Student.

The Environmental Officer, Technician, or designate is responsible for:

- Ensuring that any instrumentation, equipment, and additional supplies used for monitoring, measurement and sampling is kept in good condition appropriate for performing its intended function without interference or contamination.

- Cleaning, decontaminating, maintaining or sending out for maintenance or repair, and ordering any instrumentation, equipment and additional supplies required for monitoring, measurement and sampling.

- Ensuring that there are sufficient supplies on hand from the analytical laboratory in order to carry out the necessary sampling programs.

- Ensuring that any instruments, equipment or supplies which are beyond the point of being able to be adequately cleaned, maintained, or repaired, or are otherwise obsolete, are properly disposed of (in accordance with any applicable waste management policies and procedures).

3.0 BACKGROUND

To prevent potential cross-contamination of samples, all reusable surface water sampling equipment will be decontaminated before each use. A decontamination station can be set up onsite in a clean location upwind of sampling locations, or decontamination can be done in the field office, under a laboratory hood if available. Decontaminated equipment will be stored in a manner that will prevent recontamination prior to use. When handling decontamination chemicals, follow all relevant health and safety procedures.

This SP&P incorporates guidelines from *Protocols Manual for Water Quality Sampling in Canada* (CCME 2011), *British Columbia Field Sampling Manual* (British Columbia 2003), and *Aquatic Ecosystems Field Sampling Protocols* (Alberta 2006).

4.0 PROCEDURES

General

- Do not touch the insides of sampling containers or of their lids. Wear clean latex or nitrile gloves. Avoid eating, drinking and smoking while sampling.
- The act of sampling should not contaminate subsequent samples. For example, if sampling a small stream where sampling locations are near each other, sampling should begin downstream and proceed upstream.
- Do NOT rinse bottles with the sample water.
- Sampling equipment should be either disposable (single use only) or subjected to rigorous cleaning procedures (depending on the parameters being sampled). Clean sampling equipment should be stored in sealed new plastic bags or wrapped in new aluminum foil.

Monitoring and Sampling Instruments and Equipment

- Monitoring instruments and equipment are normally designed and intended to be used for a large number of measurements over a relatively long period of time. Thus it must be kept clean, uncontaminated, and in good repair.

- Instruments and equipment must be cleaned and maintained in accordance with the manufacturer's instructions. This will vary depending on the type of instrument or equipment, on the manufacturer, and possibly on the model used.

- In general, instruments will have a measuring probe or component; this must be kept protected in all times when not taking a measurement, such as while traveling between monitoring locations. Most instruments come with a cap, case, or some shielding or housing structure to protect the most delicate components when not directly in use. Ensure that these are used at all times when not taking a measurement.

- Some instruments will have associated supplies. For example, standalone turbidity meters use cuvettes. Both the chamber of the turbidity meter and the individual cuvettes can be cleaned. Cuvettes must also be properly stored and maintained, as scratches or dirt on the glass will result in inaccurate measurements. Cuvettes which are damaged, scratched, or too dirty to be cleaned must be thrown away.

- If a multi-parameter/multi-probe device, such as a YSI meter, sustains damage to one of its components, that component must be replaced.

Sampling Containers and Supplies

- All sampling bottles should be obtained from the appropriate analytical laboratory, only a single use, remain capped before and after actual sampling, and used for one specific sampling procedure.

- The only exception to the above point is when sampling large volumes of water for bioassay or toxicity testing, as those tests can require 40-60 L of water. This is in accordance with the two Environment Canada references cited at the end of this procedure. For example, Section *4.1 Sample Labelling,Transport and Storage* from the *Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout* document states "containers for storage and transportation of samples must be made of nontoxic material (eg. polyethylene or polypropylene carboys or pails). In this case use only brand new containers, do not reuse carboys or pails.

- Sample containers must be kept in a location where they will be protected from the weather, dust and contamination. Containers must be kept capped at all times; do not store containers uncapped or use containers which have been missing the cap.

- Do not reuse bottles. Where possible, recycle bottles and preservative vials.

- The cleanliness of sample containers can be periodically checked by having the laboratory analyze blanks.

5.0 DEVIATION FROM PROCEDURE

Adhering to this procedure will help ensure that field sampling is conducted in a hygienic manner which will not compromise the integrity of samples collected. Deviation from this procedure may result in samples being compromised or contaminated, and may provide inaccurate or misleading results due to loss of sample integrity.

6.0 KEY DOCUMENTS/TOOLS/REFERENCES

- Alberta. 2006. Aquatic ecosystems field sampling protocols. Alberta Environment. March.

- British Columbia. 2003. British Columbia Field sampling manual for continuous monitoring and the collection of air, air-emission, water, wastewater, soil, sediment and biological samples. Province of British Columbia, Ministry of Water, Land and Air Protection. January.

- CCME. 2011. Protocols manual for water quality sampling in Canada. PN 1461. Canadian Council of Ministers of the Environment.

- Environment Canada. 2007. Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout. EPS 1/RM/13. May.

- Environment Canada. 2000. Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to *Daphnia magna*. EPS 1/RM/14. December.

- Teck. 2012. Environment, Safety, Health and Community Management Standards. July.

    - Standard 13 – Monitoring – Measurement, Inspection and Audit

- USGS. 2005. National field manual for the collection of water quality data: U.S. Geological Survey techniques of water-resources investigations. Book 9, Chapters A1-A9. U.S. Geological Survey.

SAMPLER COMPETENCY AND PERFORMANCE AUDITS

Teck

Teck Coal Ltd. utilizes a system in which Standard Practices and Procedures (SP&Ps) are developed, implemented and maintained. This helps ensure that safety and environmental risks associated with various work tasks are identified, mitigated and managed.

1.0 PURPOSE

This procedure outlines the necessity of ensuring that anyone performing sampling for or on behalf of Teck Coal is competent, and that this competency will periodically be checked using performance audits.

2.0 RESPONSIBILITIES

The Environmental Superintendent or Senior Environmental Officer (senior-most position within the Environment Department, depending on the Operation) is responsible for ensuring that any training requirements for Environmental Staff is identified; this includes which SP&Ps must be reviewed and signed off. The Superintendent or Senior Officer will also ensure that any hands-on training and/or demonstration which must occur in the field are delivered.

The Senior Coordinator Environmental Performance will perform periodic audits of field sampling techniques and related procedures to ensure adherence and to identify any gaps, deviations or concerns.

3.0 BACKGROUND

Environmental monitoring and sampling projects are designed and conducted to satisfy regulatory requirements, research and development programs, management programs, and corporate or site initiatives.

Sampling activities generate data which may be used to inform and guide management and business decisions, and is often reported internally and/or externally. As such, there must be confidence in the data and samples must be collected in a manner whose methodology is acceptable and repeatable (such as in accordance with procedures detailed in the British Columbia Field Sampling Manual, the Aquatic Ecosystems Field Sampling Protocols, and/or the Protocols Manual for Water Quality Sampling in Canada).

4.0 PROCEDURES

4.1. Sampler Competency

New staff will review and sign off on any relevant SP&Ps, as determined by the senior-most person within the Environment Department. New staff will job shadow more senior staff on sampling projects (many sampling projects are done in pairs already for safety considerations); sampling and related activities will be directly supervised until the supervising employee is satisfied that competency is being consistently demonstrated.

Sampler qualification and competency can be documented in a number of ways:

- A resume, which details education and relevant work experience (kept on file by Employee Relations)
- Review and signoff of SP&Ps (tracked by onsite Training History)
- Records of attendance at technical meetings or seminars (if attendance of such events is a requirement to maintain professional status or some accreditation, it is the responsibility of the individual to document this)
- Records of attendance or relevant courses (may be tracked by attendance lists, meeting minutes, and/or by the individual if it maintains professional status or accreditation)

4.2. Performance Audits

Performance Audits are conducted to ensure that competency and adherence to documented procedures and practices is directly demonstrated. The audits will include direct observation of the sampler's activities from field trip preparation, field sampling technique, use of equipment and instruments, record keeping, and sample handling (including storage and/or shipping as appropriate).

Internal Performance Audits will occur:

- At least once a year
- Following a major change in operations
- Following a major change in procedure(s) used

- As required if any relevant audit, inspection, or incident reveals a serious concern with competency, data integrity or QA/QC

This procedure will be subject to External Audits under ISO 14001 (as part of the "Monitoring" component of an Environmental Management System); external ISO 14001 audits occur on an annual basis. It may also be subject to auditing under the Environment Health and Safety compliance audit, which is endorsed by Teck Resources, and to which each of its operations is subject every 3 years.

It must be noted that large external audits (such as ISO and the EHS compliance audits) cannot realistically audit an entire system each time, but rather take a random sampling of components and procedures to audit.

5.0 DEVIATION FROM PROCEDURE

Adherence to this procedure will ensure that Teck employees (or delegates) whose job duties include the collection of environmental samples do so in such a manner that the health and safety of the sampler is protected, and that the samples collected are representative of the medium being sampled at that time, with endorsed procedures and defensible data.

Deviation from this procedure may result in unnecessary risk to the health and safety of the sampler, or in use of a sampling method which is not approved, possibly producing data which is not defensible.

6.0 KEY DOCUMENTS/TOOLS/REFERENCES

- British Columbia. 2003. British Columbia field sampling manual for continuous monitoring and the collection of air, air-emission, water, wastewater, soil, sediment and biological samples. Province of British Columbia, Ministry of Water, Land and Air Protection. January.

- Teck. 2010. Environment, Health, Safety and Community Management Standards. December.
    - Standard 7 – Training, Education, and Disability Management

SAMPLE STORAGE AND SHIPMENT

Teck

Teck Coal Ltd. utilizes a system in which Standard Practices and Procedures are developed, implemented and maintained. This helps ensure that safety and environmental risks associated with various work tasks are identified, mitigated and managed.

1.0 PURPOSE

This procedure details the storage and shipping requirements for collected samples.

2.0 RESPONSIBILITIES

Depending on the operation, field monitoring related activities and documentation may be carried out by an Environmental Officer, Environmental Technician (not all operations have this position), or a designate, such as an Environmental Co-op Student.

The Environmental Officer, Technician, or designate is responsible for:

- Storing collected samples in a way which does not result in loss of sample integrity, and
- Shipping samples in a timely manner such as they are received and analyzed by the laboratory within accepted holding times for the specific analytes.

3.0 BACKGROUND

Samples are collected in the field on or around Teck Coal's various operations and are subsequently shipped off site to a third party laboratory for analysis (for those parameters which cannot be accurately measured in situ).

Different analytes have varying degrees of allowable holding times (the time between sample collection and laboratory analysis). Some samples can be very sensitive and have very short holding times, and need to get to a laboratory very quickly following collection.

4.0 PROCEDURES

Ensure that the sampler is aware of holding times for the samples being collected. If there are any questions regarding specific holding times for analytes, the laboratory (eg. ALS) can provide this

information. For some parameters, such as dissolved oxygen, it is far more reasonable and practical to measure in situ – dissolved oxygen has a holding time of 8 hours.

In general, it is best practice to have all samples shipped out as quickly as possible following collection. If water samples cannot be shipped on the same day during which they were collected, they must be stored in a refrigerator until they can be shipped. It is also good practice to ship samples as quickly as possible to ensure that analysis results are available in time to meet reporting requirements.

It is also best practice to schedule sampling programs such that samples can be shipped and received by the laboratory during its normal operating schedule (eg. the lab or various logistical companies may be closed on the weekend and holidays) without sitting unnecessarily in a truck or warehouse along the way. This can expose the sample to heat in the summer and cold in the winter; freezing will ruin most samples. For example, if a sample has a two day holding time, it should be shipped early in the week to allow the lab to receive it during normal operating hours.

Water samples should be kept cool, ideally around 4°C. Ship water samples in a cooler with ice packs to regulate the temperature. If there is a risk of water samples freezing, they can be shipped in a cooler with a bladder of warm water to maintain an appropriate temperature.

5.0 DEVIATION FROM PROCEDURE

Adherence to this procedure will help to ensure that samples are stored and shipped in a manner which does maintains integrity which allows for accurate laboratory results. Deviation from this procedure may result in loss of sample integrity due to improper storage or shipment which can lead to poor analytical results.

6.0 KEY DOCUMENTS/TOOLS/REFERENCES

- CCME. 2011. Protocols manual for water quality sampling in Canada. PN 1461. Canadian Council of Ministers of the Environment.
- Teck. 2012. Environment, Health, Safety and Community Management Standards. July.
    - Standard 13 – Monitoring – Measurement, Inspection and Audit
    - Standard 20 – Documents and Records

PARTICULATE SAMPLING

Teck

Teck Coal Ltd. utilizes a system in which Standard Practices and Procedures are developed, implemented and maintained. This helps ensure that safety and environmental risks associated with various work tasks are identified, mitigated and managed.

1.0 PURPOSE

This procedure outlines the procedure which will be used by environment personnel for particulate sampling. This includes passive sampling (dustfall canisters) and active sampling systems (high volume air samplers).

2.0 RESPONSIBILITIES

Depending on the operation, field monitoring activities and documentation may be carried out by an Environmental Officer, Environmental Technician (not all operations have this position), or a designate, such as an Environmental Co-op Student.

The Environmental Officer, Technician, or designate is responsible for:

- Planning and conducting the field monitoring or sampling.
- Handling dustfall canisters and filters, including shipping to the lab.

3.0 BACKGROUND

Teck Coal operations perform a variety of management activities to mitigate the creation and migration of fugitive dust. Dust is a significant environmental concern with a variety of Communities of Interest, so comprehensive and accurate measurement of dustfall is important to Teck Coal.

Dustfall canisters are passive collection devices which are exposed in the field for a pre-determined length of time (results are corrected to 30 days). They consist of a 1 L container with a mixture of water and either isopropanol (to prevent freezing in winter months) or copper sulphate (to prevent algal growth during summer months). After the exposure period, the total amount of particulate collected is measured. The laboratory may provide results as both “total dustfall” and “total fixed dustfall”; regulatory guidelines are applicable to total dustfall.

High volume (Hivol) samplers are powered devices which actively draw air through a filter for a period of time, normally 24 hours. The volume of air drawn through the hivol is calculated and the

mass of material collected by the filter is analyzed. Hivol units may measure for TSP (total suspended particulates), PM10 (particulate matter up to 10 micrometers in diameter), or PM2.5 (particulate matter up to 2.5 micrometers in diameter).

4.0 PROCEDURES

Dustfall Canisters

1. Dustfall canisters are prepared, provided and analyzed by a third party laboratory (ALS).
2. After placing in the field, remove the lid from the canister. Do not touch or place anything inside the canister. Ensure the contained solution (water and either isopropanol or copper sulphate) is appropriate for the season and weather conditions.
3. Ensure the container is properly labeled and any records are properly documented, including providing the date and time of initial exposure.
4. Results for dustfall canister particulate is corrected to a specific surface area and also to 30 days exposure. Exposure periods must coincide as closely as possible to the same calendar day each month.
5. When collecting samples from exposure, replace the lids as soon as possible and do not contaminate the inside of the container.
6. Ensure the container is properly labeled and any records are properly documented, including providing the date and time of completion of exposure.

High Volume (Hivol) Samplers

1. Hivol filters are pre-weighed, provided, and analyzed by a third party laboratory (ALS).

2. Hivol filters are extremely fragile and must never be handled with bare hands. Either wear clean latex gloves or use tongs when placing and collecting filters. Filters must be kept in a protective plastic bag at all times and only removed immediately prior to placement, then replaced into the bag immediately following collection.

3. Ensure that filters are placed in the hivol unit with the proper side facing up. It can be very difficult to visually differentiate the two sides of a filter, so if there are any questions, discuss this with the lab which provided the filters. All filters should have an assigned identification number.

4. Following filter exposure, make note of any visual defects (pinholes, tears, discoloration).

5. Sampling periods must coincide with the National Air Pollution Surveillance (NAPS) program, which is a 6 day schedule produced by Environment Canada.

6. Teck Coal utilizes different hivol units from different manufacturers (which may have differences in the types of flow rate controllers and timers), but the same principles are common to all units. Ensure that the unit is set to run for a period of 24 hours, from midnight to midnight (if possible, such as with a programmable unit) for the NAPS scheduled monitoring day. Ensure that the equipment or motor hours as well as any volumetric measurements are recorded prior to beginning any sampling period and following completion of sampling. Consult the manufacturer's instruction manual for unit operation.

7. Calibration of hivol samplers must be carried out at least every 3 months and/or after any repairs or changes to the unit which may impact the sampler calibration (eg. replacing the motor).

5.0 DEVIATION FROM PROCEDURE

Adherence to this procedure will help to ensure that samples which are analyzed for particulate matter are collected correctly. Deviance from this procedure may result in samples which are collected incorrectly, could be contaminated or damaged, and which may provide inaccurate results.

6.0 KEY DOCUMENTS/TOOLS/REFERENCES

- Alberta Environment. 1989. Air Monitoring Directive. June.
- Alberta Environment. 2006. 2006 Amendments to the Air Monitoring Directive, 1989. April.
- British Columbia. 2003. British Columbia Field sampling manual for continuous monitoring and the collection of air, air-emission, water, wastewater, soil, sediment and biological samples. Province of British Columbia, Ministry of Water, Land and Air Protection. January.
- Teck. 2012. Environment, Health, Safety and Community Management Standards. July.
    - Standard 13 – Monitoring – Measurement, Inspection and Audit
    - Standard 20 – Documents and Records

- USEPA. 1999. Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air, Compendium Method IO-2.1: Sampling of Ambient Air for Total Suspended Particulate Matter (SPM) and PM10 Using High Volume (HV) Sampler. EPA/625/R-96/010a. June.

SAMPLING SEWAGE TREATMENT PLANTS

Teck

Teck Coal Ltd. utilizes a system in which Standard Practices and Procedures are developed, implemented and maintained. This helps ensure that safety and environmental risks associated with various work tasks are identified, mitigated and managed.

1.0 PURPOSE AND SCOPE

This document outlines the procedure which will be used by environment personnel for sampling effluent and influent (where required) from sewage treatment plants to satisfy regulatory compliance. Samples are collected in a manner which meet regulatory conditions and protect the health and safety of the person(s) collecting samples.

2.0 RESPONSIBILITIES

Depending on the operation, field monitoring activities and documentation may be carried out by an Environmental Officer, Environmental Technician, or a designate, such as an Environmental Co-op Student.

The Environmental Officer, Technician, or designate is responsible for:

- Collecting effluent samples from sewage treatment plants for regulatory compliance
- Collecting influent samples from sewage treatment plants for regulatory compliance (at operations where this is required)
- Communicating analytical results of samples to the certified wastewater systems operator

Depending on the operation, sewage treatment plants may be the responsibility of the Maintenance Department or a sub-group of this department (eg. Buildings and Grounds). Day to day operations, maintenance, inspections and monitoring activities must be performed by or under the supervision of a certified wastewater systems operator. These activities are not the responsibility of the Environment Department. Samples may also be collected by the certified systems operator.

3.0 BACKGROUND

Teck Coal operations utilize various types of sewage treatment systems for treating domestic waste (black water and grey water) and to ensure that discharge to receiving environments is in compliance with regulatory conditions. Day to day operations, maintenance, inspections and

monitoring activities must be conducted by or under the supervision of qualified personnel (certified wastewater systems operator, typically within the Maintenance Department). Regulatory compliance sampling activities are typically collected by environmental personnel.

Due to the nature of sewage treatment plants and the materials and processes which occur within them, they are considered to be confined spaces and must be treated as such (in compliance with Teck Coal confined space procedures). Further, due to the nature of the materials treated in a sewage treatment plant, there are potential hygienic health and safety risks which may be present. In addition to safely and hygienically collecting samples, it is strongly recommended that any personnel conducting work (including the collection of samples) should have any related immunizations up to date (eg. diptheria, tetanus, etc.).

4.0 PROCEDURES

1. Any entry into and work within a sewage treatment plant (STP) must be in strict accordance with Teck Coal confined space procedures. Refer to the appropriate SP&P.

2. Ensure the normally required personal protective equipment (PPE) is worn, including safety glasses. Additional and appropriate PPE must be worn, including at a minimum, water proof gloves (rubber, nitrile, latex, etc). The sampler should also consider, especially in circumstances when influent is sampled, a disposable rain jacket and a full face shield to prevent any potential splashing from contacting the sampler. Gloves and rain jackets are to be properly disposed of following sampling.

3. Grab samples are normally collected, but where possible, it is recommended to use automated water samplers to avoid contact with materials (effluent and especially influent, if sampling is required).

4. Where grab samples are taken, collect the sample in a manner which avoids direct contact with the materials being sampled. In some cases a sample can be collected in a controlled manner from a tap or valve at the discharge end of a treatment plant. If a sample is collected from a discharging pipe or some structure where flow cannot be controlled, use a rod or stick to hold the bottle at a distance to collect the sample. In all instances, avoid any splashing and direct contact.

5. Cap the sample bottle and tape the lid to avoid any spilling or leakage. Ensure that the exterior of the bottle(s) is (are) clean and dry. Properly dispose of any paper towel used for cleaning.

6. Place the filled sample bottle(s) into a plastic bag and into a dedicated cooler (separate from any other non-STP samples to avoid contamination).

7. Following sampling, and as soon as reasonably practicable, wash your hands. Do not touch your face, eat or drink until after your hands are clean.

8. Package and ship the samples as soon as possible. Wash up following any further handling activities.

5.0 DEVIATION FROM PROCEDURE

Adherence to this procedure will help to ensure that samples collected in a safe and sanitary manner and which satisfy regulatory requirements. Deviation from this procedure may put the sampler at unnecessary health and safety risk and/or may result in improperly collected samples.

6.0 KEY DOCUMENTS/TOOLS/REFERENCES

- British Columbia. 2003. British Columbia Field sampling manual for continuous monitoring and the collection of air, air-emission, water, wastewater, soil, sediment and biological samples. Province of British Columbia, Ministry of Water, Land and Air Protection. January.
- Teck. 2012. Environment, Health, Safety and Community Management Standards. July.
    - Standard 1 – Safety, Health and Occupational Hygiene
    - Standard 4 – Water, Ecosystems and Biodiversity
    - Standard 13 – Monitoring – Measurement, Inspection and Audit
    - Standard 20 – Documents and Records
- Water Environment Federation. 2008. Safety Corner – Recommended Immunizations, WE&T Magazine, Vol. 20 No. 1 (http://www.wef.org/publications/page_wet.aspx?id=4645&page=ca&section=Safety%20Corner). January.

SAMPLING POTABLE WATER

Teck

Teck Coal Ltd. utilizes a system in which Standard Practices and Procedures are developed, implemented and maintained. This helps ensure that safety and environmental risks associated with various work tasks are identified, mitigated and managed.

1.0 PURPOSE AND SCOPE

This document outlines the procedure which will be used by environment personnel for sampling treated potable water to satisfy regulatory compliance. Samples are collected in a manner which meet regulatory conditions and protect the health and safety of the person(s) collecting samples.

2.0 RESPONSIBILITIES

Depending on the operation, field monitoring activities and documentation may be carried out by an Environmental Officer, Environmental Technician, or a designate, such as an Environmental Co-op Student.

The Environmental Officer, Technician, or designate is responsible for:

- Collecting potable water samples for regulatory compliance
- Communicating analytical results of samples to the certified water systems operator

Depending on the operation, potable water treatment systems may be the responsibility of the Maintenance Department or a sub-group of this department (eg. Buildings and Grounds). Day to day operations, maintenance, inspections and monitoring activities must be performed by or under the supervision of a certified water systems operator. These activities are not the responsibility of the Environment Department. Samples may also be collected by the certified systems operator.

3.0 BACKGROUND

Teck Coal operations utilize various types of treatment systems for producing treated potable water used for washing, cooking, and often drinking (although some operations also provide bottled water). Day to day operations, maintenance, inspections and monitoring activities must be conducted by or under the supervision of qualified personnel (certified wastewater systems operator, typically within the Maintenance Department). Regulatory compliance sampling activities are typically collected by environmental personnel.

4.0 PROCEDURES

1. Samples are collected from a faucet at any location within the treated water distribution system. Turn on the cold water (do not use the hot water tap) and allow the water to run for several minutes prior to sampling. This allows any stagnant water which may have been sitting in the lines to flush and allows for a more representative sample.

2. Wear nitrile or latex gloves while sampling. Do not touch the insides of any bottles or lids.

3. Do not allow any bottles or lids to directly contact the faucet, as this may contaminate the sample.

4. Use laboratory certified clean sample containers for sampling. Do not rinse any bottles.

5. Collect the sample. Preserve if necessary (note that some sampling containers for common potable water analytes will already contain preservative; be careful not to overfill the container and risk washing away preservative). If dissolved analytes are being sampled for, filtration is required prior to preserving the sample. If the sample is not going to be filtered, do not preserve it; have the lab filter and then preserve the sample.

6. Cap the filled sample container. Ensure the container is clean and dry. Place it into a cooler.

7. Package and ship the samples as quickly as possible following sampling. Many analytes sampled for in potable water can be sensitive and have short holding times.

5.0 DEVIATION FROM PROCEDURE

Adherence to this procedure will help to ensure that potable water is collected in a manner which prevents contamination and ensures that samples are representative of the treated water within the distribution system. Deviation from this procedure may result in poor sample quality and/or contamination of samples.

6.0 KEY DOCUMENTS/TOOLS/REFERENCES

- Alberta Environment. 2009. Alberta Environment's Drinking Water Program – A 'Source to Tap, Multi-Barrier' Approach. May.
- British Columbia. 2003. British Columbia Field sampling manual for continuous monitoring and the collection of air, air-emission, water, wastewater, soil, sediment and biological samples. Province of British Columbia, Ministry of Water, Land and Air Protection. January.
- British Columbia Ministry of Health. 2001. Drinking Water Protection Act. April.
- Health Canada. 2012. Guidelines for Canadian Drinking Water Quality Summary Table. August.
- Teck. 2012. Environment, Health, Safety and Community Management Standards. July.
    - Standard 1 – Safety, Health and Occupational Hygiene
    - Standard 4 – Water, Ecosystems and Biodiversity
    - Standard 13 – Monitoring – Measurement, Inspection and Audit
    - Standard 20 – Documents and Records

BACTERIOLOGICAL SAMPLING

Teck

Teck Coal Ltd. utilizes a system in which Standard Practices and Procedures are developed, implemented and maintained. This helps ensure that safety and environmental risks associated with various work tasks are identified, mitigated and managed.

1.0 PURPOSE AND SCOPE

This document outlines the procedure which will be used by environment personnel for sampling treated potable water for bacteriological analysis.

2.0 RESPONSIBILITIES

Depending on the operation, field monitoring activities and documentation may be carried out by an Environmental Officer, Environmental Technician, or a designate, such as an Environmental Co-op Student.

The Environmental Officer, Technician, or designate is responsible for:

- Collecting potable water samples for bacteriological analysis
- Communicating analytical results of samples to the certified water systems operator. The presence of *e. coli* and/or total or faecal coliforms can indicate inadequate water treatment or system issues which could result in health and safety risk to anyone using or consuming treated potable water.

3.0 BACKGROUND

Teck Coal operations utilize various types of treatment systems for producing treated potable water used for washing, cooking, and often drinking (although some operations also provide bottled water). This water needs to be ensured as safe by demonstrating the absence of potential pathogenic indicators, including *e.coli* and faecal coliforms.

From the *Guidelines for Canadian Drinking Water Quality:*

- *"E. coli* is used as an indicator of the microbiological safety of drinking water; if detected, enteric pathogens may also be present. The presence of *e. coli* indicates recent faecal contamination and the potential presence of microorganisms capable of causing gastrointestinal illnesses."

- Heterotrophic plate count (HPC) "*is a useful operational tool for monitoring general bacteriological water quality through the treatment process and in the distribution system*".

4.0 PROCEDURES

1. The sampler must ensure that their hands are clean prior to collecting the sample. Even when the sampler has clean hands and is wearing gloves, do not touch the inside of the sample bottle or lid as this can contaminate the sample.

2. Use only clean sample bottles provided by the laboratory.

3. Samples are collected from a faucet at any location within the treated water distribution system. Turn on the cold water (do not use the hot water tap) and allow the water to run for several minutes prior to sampling. This allows any stagnant water which may have been sitting in the lines to flush and allows for a more representative sample.

4. It is good practice to vary sampling locations from throughout the entire distribution system from one sample to the next.

5. Slow down the flow rate of the water from the tap. Do not rinse the sample bottle prior to sampling – it contains preservative (sodium thiosulphate) which must not be rinsed out.

6. Fill the sample bottle to the line indicated on the bottle. Cap immediately after collection is complete.

7. Ensure the container is clean and dry. Place it into a cooler.

8. Measure and record turbidity and residual chlorine of the potable water immediately before or after sample collection. This information can be very important in the case of a positive bacteriological sample, as either low chlorine or high turbidity can potentially lead to a positive result for bacterial presence.

9. Package the sample with an ice pack and ship as quickly as possible following sampling. Bacteriological samples have a holding time of 24 hours. The laboratory will not analyze samples outside of the holding time, or samples which have frozen during transport.

5.0 DEVIATION FROM PROCEDURE

Adherence to this procedure will help to ensure that sampling potable water for bacteriological analysis is conducted in a manner which prevents sample contamination and provides meaningful results. Deviation from this procedure may result in sample contamination which could provide false positive results.

6.0 KEY DOCUMENTS/TOOLS/REFERENCES

- Alberta Environment. 2009. Alberta Environment's Drinking Water Program – A 'Source to Tap, Multi-Barrier' Approach. May.
- British Columbia. 2003. British Columbia Field sampling manual for continuous monitoring and the collection of air, air-emission, water, wastewater, soil, sediment and biological samples. Province of British Columbia, Ministry of Water, Land and Air Protection. January.
- British Columbia Ministry of Health. 2001. Drinking Water Protection Act. April.
- Health Canada. 2012. Guidelines for Canadian Drinking Water Quality Summary Table. August.
- Teck. 2012. Environment, Health, Safety and Community Management Standards. July.
    - Standard 1 – Safety, Health and Occupational Hygiene
    - Standard 4 – Water, Ecosystems and Biodiversity
    - Standard 13 – Monitoring – Measurement, Inspection and Audit
    - Standard 20 – Documents and Records

MEASUREMENT OF WATER TABLE ELEVATION IN WELLS

Teck

Teck Coal Ltd. utilizes a system in which Standard Practices and Procedures are developed, implemented and maintained. This helps ensure that safety and environmental risks associated with various work tasks are identified, mitigated and managed.

1.0 PURPOSE AND SCOPE

This document outlines the procedure which will be used by personnel for measuring water depth in wells, observation wells, and piezometers.

2.0 RESPONSIBILITIES

Depending on the operation, field monitoring activities and documentation may be carried out by an Environmental Officer, Environmental Technician (not all operations have this position), or a designate, such as an Environmental Co-op Student.

The Environmental Officer, Technician, or designate is responsible for:

- Measuring the depth to groundwater in a structure (well, observation well, piezometer)

3.0 BACKGROUND

Depth to groundwater surface is measured using an electric water level meter (such as Solinst Model No. 101 or equivalent). A light on the water level meter illuminates and/or an audible alarm sounds when the weighted probe tip contacts the water surface in the well and completes an electronic circuit. The measured depth to water is determined to within 0.01 meter by noting the point on the probe cable that corresponds to the measuring point (MP) at the top of the well/piezometer casing at the initial point of contact.

4.0 PROCEDURES

The following steps are necessary to collect water level measurements:

1. Check the operation of the meter by turning on the indicator switch and pressing the test button.

2. Holding the water level indicator above the well casing, lower the cable gradually into the well or piezometer until the indicator contacts the water surface. The contact with water surface is indicated by the buzzer sounding and/or illumination of the indicator light. At this point, stop lowering the cable.

3. Note the point on the graduated cable that corresponds to the MP at the top of the casing when the electronic circuit is first completed. The MP should be the inner casing and not the outer casing that is protecting the well. If the inner casing cannot be reached and the outer casing is used as the MP, then this must be recorded in the datasheet. If necessary, grasp tape with thumb and index finger exactly at the measuring point marked at the top of the well casing. Pull tape out of well slowly and read measurement.

4. Record the depth to the water surface to the nearest 0.01 m.

5. Draw the cable about 0.25 above the surface of the water, then lower it and repeat Steps 2 through 4. If these two readings differ by more than 0.02 m, repeat until the measured readings stabilize. Measurements should always be taken as the indicator is lowered into the well, not as it is raised.

5.0 DEVIATION FROM PROCEDURE

Adherence to this procedure will help to ensure that depth to water is measured properly, can be consistently repeated, and provides accurate data for measurement of water table elevation. Deviation from this procedure may result in improper measurement of water depth and inaccurate data being recorded.

6.0 KEY DOCUMENTS/TOOLS/REFERENCES

- Teck. 2012. Environment, Health, Safety and Community Management Standards. July.
    - Standard 4 – Water, Ecosystems and Biodiversity
    - Standard 13 – Monitoring – Measurement, Inspection and Audit
    - Standard 20 – Documents and Records

MONITORING WELL PURGING AND GROUNDWATER SAMPLING

Teck

Teck Coal Ltd. utilizes a system in which Standard Practices and Procedures are developed, implemented and maintained. This helps ensure that safety and environmental risks associated with various work tasks are identified, mitigated and managed.

1.0 PURPOSE AND SCOPE

This document outlines the procedure which will be used by Teck Coal for purging, monitoring and sampling groundwater from monitoring wells. This is applicable to more routine monitoring programs such as compliance monitoring, and not necessarily to research and development programs, which may require far more detailed water chemistry.

2.0 RESPONSIBILITIES

Depending on the operation, field monitoring activities and documentation may be carried out by an Environmental Officer, Environmental Technician (not all operations have this position), or a designate, such as an Environmental Co-op Student.

The Environmental Officer, Technician, or designate is responsible for:

- Purging the well as possible prior to performing any monitoring or sampling activities.
- Collecting the water sample(s)

3.0 BACKGROUND

It is recommended that a low-flow pump is used to sample groundwater where possible. This is not always a feasible or practical methodology. Having to use a pump, power source, and associated equipment can be a major hindrance, especially for sampling locations which may be remote and/or off of roadways or good pathways.

Manual methods to purge and collect groundwater include use of bailers or plastic tubing with foot valves to allow water to be pumped one-way by hand. Dedicated plastic tubing with foot valves is inexpensive, effective, easy to use and can be set up so that each monitoring well has its own dedicated tubing. This would eliminate potential for cross-contamination between wells. Bailers can also be used for purging and sampling, and are inexpensive and very portable. If bailers are used, care must be taken to prevent contamination from one well to the next. Either

bailers need to be disposable (single use), or carefully cleaned and decontaminated between sampling locations.

4.0 PROCEDURES

Actively producing well

If a dewatering well has been installed and is actively being used to lower or control the water table, then samples can likely be collected at the surface. Either sample at the discharge point of the pump (hard or soft line) or from a tap installed at the well head.

Monitoring Well or Piezometer

A monitoring well or piezometer is a passive structure (no permanent pump installed) and so water must be brought to the surface manually or by use of a low flow pump.

Water can be brought to the surface for measurement and sample collection using a low flow pump, plastic tubing and one-way foot valve, or bailer.

Preparation

Preparation includes inspecting the condition of the well, monitoring health and safety conditions, and calibrating and decontaminating equipment. General procedures are presented below:

1. Make sure area around well head is clean and free of debris. If necessary, place a plastic drop cloth around the well head to prevent sampling equipment from coming into contact with the ground surface.
2. Inspect condition of well (e.g., well locked, loose-fitting cap, measuring point well marked, surface casing disturbed, well casing straight, condition of concrete pad). Indicate condition of well on the datasheet.
3. All equipment should be decontaminated before and after introduction to each well. Protective latex or nitrile gloves should be worn during possible water-contact or equipment-contact activities. At a minimum, gloves should be changed between each well or when introduction of potential contaminants to the well is possible.

4. Measure water level using an electronic water level meter as described in SP&P TC-GW-01. Sounding the bottom of the well using a weighted tape (i.e., for well casing volume calculations) before sampling is not recommended to avoid resuspension of settled solids. If possible, determine the elevation of the well bottom from drilling records.

5. Calculate the well casing volume as follows:

$$\text{well casing volume (L)} = \pi (r^2)(h)(1000\ L/m^3)$$

where h = height of water in the well casing (i.e., depth to bottom of the well minus depth to water (in m), and r = radius of well casing (in m).

6. Calibrate water quality meters for measuring field parameters as appropriate. At a minimum, temperature, pH, specific conductance, and turbidity measurements should be collected during purging and before sampling. Record equipment calibration and maintenance in the equipment log sheets. Decontaminate meters between wells by rinsing with distilled water.

Well Purging

Where reasonably practicable, it is recommended that 3-4 purge volumes of water is removed from the well. Monitoring wells are purged before groundwater samples are collected for analyses. The purpose of well purging is to remove stagnant groundwater from the well (which has interacted with air in the well casing).

The well must then be allowed to recharge prior to sampling. In some cases, such as encountering a very low production and/or essentially dry well, it is not feasible to purge 3-4 volumes of water. If this situation is encountered, be sure to keep good records of the field conditions experienced, the volume of water purged, and notes detailing why 3-4 purge volumes are not possible. Also record any visual observations of the water purged, such as color, turbidity, odor, presence of invertebrates (eg. mayfly larva) etc., which may provide useful information about the state of the well.

Field parameters (i.e., at a minimum pH, temperature and specific conductance) are measured during the purging process (See SOP TC-GW-03).
Purging is assumed to be complete when the readings of these parameters have stabilized.

It is recommended that purging takes place the day before sampling. The well needs to have the stagnant water removed and then recharge. However, recharge water should not sit for too

long prior to sampling, as it can react again with air in the casing and become unrepresentative of the groundwater in the area.

1. Lower the pump intake or intake tubing (as applicable) into the water column. The pump intake should be placed at the middle or slightly above the middle of the screened interval in confined aquifers. Placement of the pump intake near the top of the water column is recommended for unconfined aquifers screened across the water table.
2. Conduct purging at a rate that is lower than used to develop the well and that will minimize drawdown in the well. Recommended purge rates for low-flow sampling are generally less than 0.5 L/min, or a rate that results in minimal (i.e., less than 0.3 m) drawdown in the well. Actual purge rates will vary on the basis of aquifer material, well construction, and purging equipment.
3. Continue purging the well until field parameters have stabilized. Field parameters are stable when three successive readings are within ± 0.1 for pH, ±3 percent for conductivity, ± 0.2 °C for temperature, ± 10 mV for redox potential and ± 10 percent for turbidity and dissolved oxygen.
4. After the field parameters have stabilized, reduce the pump rate to approximately 0.1 L/min or the lowest possible flow setting for the particular pump. Pump should be operated at a rate less than 0.1 L/min when collecting samples for VOC analysis.
5. In the event that even very low purge rates result in emptying of the well, groundwater samples for laboratory analyses should be collected as soon as sufficient groundwater accumulates in the well, regardless of field parameters or total volume purged.

Groundwater Sampling

- Groundwater sampling is conducted after proper purging of the well.
- Where possible, groundwater samples for analyses should be collected directly from the pump discharge at the lowest rate possible to minimize cross contamination, suspension of solids, and aeration of the sample.
- Both bladder pumps and submersible pumps are suitable for purging and sampling of all groundwater parameters. A bailer may be used to collect groundwater samples for laboratory analyses of volatile organic compounds; however, the peristaltic pump is suitable for collection of semivolatile organic compounds (SVOCs), metals, and general chemistry parameters.

- Bailers are not recommended for purging or sampling of groundwater monitoring wells because they may agitate solids in and next to the well.

1. Groundwater samples should be introduced directly from the pump discharge into the proper sample container and filled to capacity.
2. In general, groundwater samples collected for multiple compounds should be collected in the following order:
   - Volatile organic compounds (VOCs)
   - Dissolved gasses and total organic carbon (TOC)
   - SVOCs (such as polycyclic aromatic hydrocarbons)
   - Metals and cyanide
   - Major water quality cations and anions
   - Radionuclides.
3. In some cases, field filtration may be required (e.g., metals). Filtered water should be introduced directly into the appropriate sample container. If samples cannot be filtered in the field, do not preserve them. The receiving lab can filter then preserve.
4. If applicable, remove the pump or tubing from the well. Close and lock the well. Decontaminate the sampling equipment.

5.0 DEVIATION FROM PROCEDURE

Adherence to this procedure will ensure that wells are purged and sampled correctly. Deviation from this procedure may result in improper collection of samples which yield poor or incorrect data, or to unnecessary health and safety risk to the person(s) collecting the sample(s).

6.0 KEY DOCUMENTS/TOOLS/REFERENCES

- British Columbia. 2003. British Columbia field sampling manual for continuous monitoring and the collection of air, air-emission, water, wastewater, soil, sediment and

biological samples. Province of British Columbia, Ministry of Water, Land and Air Protection. January.

- Teck. 2012. Environment, Health, Safety and Community Management Standards. July.
    - Standard 4 – Water, Ecosystems and Biodiversity
    - Standard 13 – Monitoring – Measurement, Inspection and Audit
    - Standard 20 – Documents and Records
- U.S. EPA. 1993. Ground water sampling—a workshop summary. EPA/600/R-94/205. U.S. Environmental Protection Agency, Robert S. Kerr Environmental Research Laboratory, Ada, OK.

METEOROLOGICAL MONITORING PROCEDURE

Teck

Teck Coal Ltd. utilizes a system in which Standard Practices and Procedures are developed, implemented and maintained. This helps ensure that safety and environmental risks associated with various work tasks are identified, mitigated and managed.

1.0 PURPOSE AND SCOPE

This document outlines the procedure which will be used by Teck Coal for monitoring and measuring meteorological conditions.

2.0 RESPONSIBILITIES

Depending on the operation, field monitoring activities and documentation may be carried out by an Environmental Officer, Environmental Technician (not all operations have this position), or a designate, such as an Environmental Co-op Student.

The Environmental Officer, Technician, or designate is responsible for:

- Performing routine inspections of meteorological equipment and instrumentation.
- Noting any maintenance and/or repair activities which need to be conducted and either performing or scheduling these activities.
- Shipping out components for calibration and/or scheduling a qualified expert for on-site calibration activities.
- Recording measurements and/or downloading electronic data.
- Ensuring records are properly stored and are retrievable.

3.0 BACKGROUND

Meteorological data is often supportive of other monitoring programs (eg. flow monitoring, dust monitoring) and used predictively for construction projects (eg. settling ponds). It is also reported to regulators and sometimes other Communities of Interest (COI).

The mine sites can experience meteorological extremes including temperature, wind speed, and precipitation, and weather is extremely variable throughout the course of a year.

Most meteorological stations consist of electronic and mechanical instrumentation and a datalogger. The station may be viewable over a network, may be communicated with by

satellite or radio, or may be standalone and requiring periodic direct connection of a computer for downloading data.

Routine parameters measured include:

- Temperature
- Wind speed
- Wind direction
- Precipitation
- Air pressure
- Humidity

Due to the severity and extreme variation of weather conditions experienced at Teck Coal operations, it is recommended that a qualified professional visits all stations at least annually for maintenance, repair and calibration. In particular, extreme wind speeds can be damaging to wind anemometers, and they should be inspected annually and calibrated at least bi-annually, as moving parts (bearings) can wear out more quickly than normal.

Manual equipment may also be used but is best utilized as a redundancy or backup for powered electronic instruments. Manual equipment may include rain gauges, minimum/maximum thermometers, and snow boards.

4.0 PROCEDURES

Manual equipment should mainly be used as a check on electronic instrumentation or to fill in data gaps in the event that electronic equipment goes down. Equipment should be set up in an easily accessible, well-frequented area (such as near an office or some routinely visited infrastructure) so that measurements can be made on a very routine basis.

Inspections and observations must be recorded on an appropriate form or in a logbook.

Electronic instrumented stations should ideally be able to be communicated with remotely so that data can be reviewed regularly for completeness (no gaps due to issues such as lost power) and as a quick glance to ensure measurements are reasonable. For remotely accessible stations, data should be downloaded at least weekly to avoid unnecessary data gaps. Those stations which are not remotely accessible but must be connected to directly, such as with a laptop, should be visited at least monthly to ensure that any data gaps or missed measuring periods are not unnecessarily long.

Wind direction sensors must be oriented to true north. If the meteorological station includes a datalogger, wind direction must be determined to the nearest degree.

Inspections

Stations should be physically visited and inspected at least quarterly. Inspections should include:

- Ensuring that instrumentation and equipment appears ok and undamaged. Potential sources of damage include windblown debris, vandalism, animals, and severe weather.
- Ensuring that the station is still properly orientated (eg. wind anemometers are corrected to true north to properly measure wind direction, solar panels should be ideally placed to receive maximum solar input)
- Ensure that the fiberglass cabinet is properly closed and sealed, and that desiccation packs are still effective.
- Ensure that the datalogger is receiving input signals from the connected instrumentation (there may be a blinking "scan" light on the datalogger which indicates this).

Inspections and observations must be recorded on an appropriate form or in a logbook.

Maintenance and Calibration

Stations should either be visited annually by a qualified professional, or their components should be swapped out and sent in for service. Wind anemometers must be mechanically inspected (bearings are subject to wear) and calibrated at least every two years. Service records and calibration records must be kept on file.

5.0 DEVIATION FROM PROCEDURE

Adherence to this procedure will help ensure that meteorological stations are properly inspected, maintained and calibrated, and that data is accurate and doesn't contain large gaps. Deviation from this procedure may result in unnecessary wear to stations, insufficient calibration, data loss and/or poor data.

6.0 KEY DOCUMENTS/TOOLS/REFERENCES

- Alberta. 1989. Air Monitoring Directive. Monitoring and Reporting Procedures for Industry. June.
- Teck. 2012. Environment, Health, Safety and Community Management Standards. July.
    - Standard 13 – Monitoring – Measurement, Inspection and Audit
    - Standard 20 – Documents and Records

SUMP SAMPLING

Teck

Teck Coal Ltd. utilizes a system in which Standard Practices and Procedures are developed, implemented and maintained. This helps ensure that safety and environmental risks associated with various work tasks are identified, mitigated and managed.

1.0 PURPOSE

This procedure outlines the procedure which will be used by Teck Coal to collect representative samples from sumps for laboratory analysis. Analytical results from samples will be used to inform and ensure proper disposal of sump materials. Samples will be collected in a manner which protects the health and safety of personnel performing the sampling.

2.0 RESPONSIBILITIES

The Environmental Officer, Technician, or designate is responsible for:

- Collecting the water sample(s) from the sump
- Completing the necessary paperwork and shipping the sample
- Communicating the analytical results to the appropriate personnel (such as those involved in handling and disposal of sump water)

3.0 BACKGROUND

Vehicles used at the operations are regularly cleaned in wash bays with wastewater reporting to a collection system and sump. This includes washing of bulk trucks and tankers owned by the blasting contractor (Maxam Bulk Services). When washing these units, a detergent is used which breaks the emulsion bonds and renders the emulsion product inert. Thus any products contained in the wastewater storage sumps are non-explosive.

Sump sampling is not conducted to directly satisfy a regulatory condition (such as from a permit or approval). Rather, it is conducted to ensure that the subsequent disposal of sump material is done in a manner which complies with regulations and which is safe and environmentally responsible.

Wastewater in collection systems such as sumps will tend to be a very dilute but likely heterogenous mixture. As such, a simple grab sample may not be representative of the total contents of the sump.

4.0 PROCEDURES

Ensure that the sampler is wearing appropriate PPE, including gloves (nitrile, latex, etc). The sample to be collected is intended to be representative of the overall liquid mixture within the sump (or other containment). To accomplish this may be accomplished by collecting a large grab sample, mixing sufficiently, then collecting a representative subsample, or by using a composite sampler.

1. Use a large container (eg. 20 L pail) to collect a sample from the sump. Sufficiently mix the sample until it appears homogenous, then collect a subsample into a smaller container (eg. 500 ml glass jar).

2. Use a composite sampler designed for sampling heterogenous liquids (Coliwasa is one example):

   Using a Coliwasa (COmposite LIquid WAste SAmpler) or similar unit designed for sampling a heterogenous liquid mixture:

   - Pull up on the top of the rod to open the valve
   - Lower the unit into the water in the sump
   - Once the desired level has been reached, pull on the rope connected to the top of the unit. This will close the check valve and contain a sample in the unit.
   - Remove the unit from the sump.

- Pull on the plastic rod to open the valve and allow the transfer of sample water into a bottle or container (provided by the laboratory) to ship for analysis.

5.0 DEVIATION FROM PROCEDURE

Adherence to this procedure will help ensure that samples representative of the total materials in sumps are collected to allow effective analysis and subsequent disposal in a manner which protects the health and safety of the sampler as well as anyone subsequently handling the sample. Deviation from this procedure may result in improper sampling, unnecessary risks to the sampling personnel, results which are not representative of total sump materials, and/or ill-informed or improper disposal of sump materials.

6.0 KEY DOCUMENTS/TOOLS/REFERENCES

- Maxam Bulk Services Internal Document. 2012. Disposal of Emulsion Residue. MBS-OP-015. July 13.
- Teck. 2010. Environment, Health, Safety and Community Management Standards. December.
    - Standard 11 – Documentation and Document Control
    - Standard 16 – Monitoring and Inspection
    - Standard 18 – Record-keeping
- United States Environmental Protection Agency. 2007. SESD Operating Procedure – Waste Sampling. SESDPROC-302-R1. November 1.

MEASUREMENT OF SURFACE WATER FIELD PARAMETERS PROCEDURE

Teck

Teck Coal Ltd. utilizes a system in which Standard Practices and Procedures are developed, implemented and maintained. This helps ensure that safety and environmental risks associated with various work tasks are identified, mitigated and managed.

1.0 PURPOSE AND SCOPE

This document outlines the procedure which will be used by Teck Coal to conduct measurements of various parameters in surface waters. This procedure is applicable to routinely conducted monitoring activities, such as those required for compliance monitoring, and to measurements done in relatively shallow waters (≤ 2m). Monitoring activities conducted for research and development projects may require additional parameters which are not included in this procedure and may also require very specialized monitoring procedures (which will be covered elsewhere). Monitoring performed in deep waters or at multiple depths through a water column (such as an end pit lake) has special considerations not covered in this SP&P.

Measurements to assess compliance or evaluate environment, health and safety, and community (EHSC) related performance will be conducted in a manner consistent with relevant regulatory and/or industry standards, and will utilize appropriate methods and techniques. Measurement equipment used for compliance or performance evaluation, or for purposes of EHSC-related control will be:

- Fit for purpose
- Suitably calibrated
- Adequately protected from damage or unintentional adjustment, and
- Maintained in good working order

2.0 RESPONSIBILITIES

The Environmental Officer, Technician, or designate is responsible for:

- Performing field measurements for various physical and chemical characteristics of water
- Recording field measurements appropriately (as per TC-GEN-02)

- Ensuring that routine maintenance and calibration activities are conducted
- Sending out instruments and equipment for service as required
- Communicating the analytical results to the appropriate personnel (such as those involved in handling and disposal of sump water)

3.0 BACKGROUND

Monitoring is routinely performed to evaluate the extent to which environmentally related expectations are being met. This includes evaluating compliance with legal and other requirements, general environmental performance, whether set objectives and targets are being met, whether environmental risks are being effectively controlled, and the effectiveness of management systems.

Several physical and chemical water parameters are best measured in the field because of the unstable nature of the parameter or because the information is needed to direct further sampling. *In situ* measurements of parameters such as pH, dissolved oxygen (DO), temperature, conductivity and turbidity are routinely taken at the time of sampling. Flow measurements are also routinely conducted in the field, but will be covered elsewhere.

It is preferred to collect measurements from the body of water itself. Occasionally, it may be necessary to take the measurements from a subsample of water (for example, measuring temperature of a deep water sample with a thermometer). In this case, take separate water samples in a 1-L "field bottle" for these field measurements. Never take field measurements from samples to be submitted to the laboratory for analysis.

4.0 PROCEDURES

Field measurements may be taken using a multi-probe instrument (eg. YSI 556) or by using a series of individual instruments, each of which can measure one or more parameters.

Maintenance and calibration

Field instruments should be calibrated and maintained as required in order to get accurate results. Field personnel must understand the calibration and use of any instrument they are

using in the field. Records for maintenance (including cleaning, such as regular cleaning of any probes) and calibration must be kept up to date to track the performance of the instruments. Manufacturer's instructions should be followed for calibration; calibration methods and frequencies are instrument specific and will be specified in these documents.

Note that manufacturer's manuals aren't necessarily comprehensive and often only suggest the minimum frequency calibration. Where reasonably practicable, meters should be calibrated prior to each field trip. Some probes or meters, such as dissolved oxygen, may require periodic calibrations throughout a single day (eg. if water quality changes dramatically between sites, if there are significant differences in altitude, temperature, etc).

Always calibrate pH meters to at least two points, three if possible. Never calibrate with only a single buffer solution.

In general, instruments should be sent out to a qualified third party for servicing on an annual basis and further as required. Instruments should not be stored for long periods with the batteries inside.

Re-measure and double check any dubious readings before leaving the locations. Verifications at the end of the day for some key parameters (not re-calibrations) to check if the meter has drifted or is malfunctioning may be worthwhile. Probe readings should be checked in standard solutions and recorded on the datasheets. This ensures that the instrument has been working properly throughout the day.

Field Measurements

Field measurements should be taken just below the surface of the water. Allow all measurements to come to equilibrium before reading and recording the value; note that this may take several minutes, depending on the parameter being measured.

Some parameters, such as temperature, should only be measured in situ. Other parameters (eg. dissolved oxygen, pH) are best measured in situ, as they are temperature dependent and their values could change en route to a laboratory.

Temperature is a parameter which is measured by many instruments; where possible, measure it using a combined dissolved oxygen and temperature meter. Solubility of oxygen is strongly temperature dependent, so these parameters need to be well correlated.

It is preferable that dissolved oxygen is measured using a membrane electrode method, such as with a multi-probe meter. Do not use a chemical titration method (Winkler method) in the field.

Periodically check field measurements against laboratory analysis. For example, measure turbidity in the field and collect a sample to have a laboratory analyze for it also.

When instruments are not in use, such as when they are in transport, ensure that sensitive components are protected. Ensure any protective caps or lids are in place or that instruments are in their cases. Turn instruments off when not in use to prevent draining batteries and to prevent any unintended adjustments to settings or calibration.

5.0 DEVIATION FROM PROCEDURE

Adherence to this procedure will help to ensure that instruments are properly maintained, calibrated, and capable of taking accurate measurements in the field. Deviation from this procedure may result in inaccurate measurements which can result in poor or incorrect data.

6.0 KEY DOCUMENTS/TOOLS/REFERENCES

- Alberta. 2006. Aquatic ecosystems field sampling protocols. Alberta Environment. March.
- British Columbia. 2003. British Columbia field sampling manual for continuous monitoring and the collection of air, air-emission, water, wastewater, soil, sediment and biological samples. Province of British Columbia, Ministry of Water, Land and Air Protection. January.
- CCME. 2011. Protocols manual for water quality sampling in Canada. PN 1461. Canadian Council of Ministers of the Environment.
- Operations manuals for specific instruments.
- Teck. 2012. Environment, Health, Safety and Community Management Standards. July.
    - Standard 4 – Water, Ecosystems and Biodiversity
    - Standard 13 – Monitoring – Measurement, Inspection and Audit
    - Standard 20 – Documents and Records

SURFACE WATER SAMPLING PROCEDURE

Teck

Teck Coal Ltd. utilizes a system in which Standard Practices and Procedures are developed, implemented and maintained. This helps ensure that safety and environmental risks associated with various work tasks are identified, mitigated and managed.

1.0 PURPOSE AND SCOPE

This document outlines the procedure which will be used by Teck Coal to conduct sampling for various analytes in surface waters. This is applicable to routine sampling activities, such as for compliance monitoring and evaluation of environmental performance. Sampling for research and development projects may have other specific considerations and/or require other specialized techniques.

2.0 RESPONSIBILITIES

The Environmental Officer, Technician, or designate is responsible for:

- Preparing the necessary supplies and sampling containers to complete the sampling project
- Collecting the water sample(s)
- Be observant and make any records of unusual conditions at a site which the sampler is familiar with

3.0 BACKGROUND

Samples are often collected from surface waters by submerging and filling a container just below the surface of the water – these are called grab samples. Teck Coal operations are subject to regulatory requirements to collect grab samples at a number of locations. Further, Teck Coal may also perform additional sampling to meet other requirements (including internally) which require data from analysis of samples.

Measurements to assess compliance or evaluate environment, health and safety, and community (EHSC) related performance will be conducted in a manner consistent with relevant regulatory and/or industry standards, and will utilize appropriate methods and techniques.

Measurement equipment used for compliance or performance evaluation, or for purposes of EHSC-related control will be:

- Fit for purpose
- Suitably calibrated
- Adequately protected from damage or unintentional adjustment, and
- Maintained in good working order

4.0 PROCEDURES

General Sampling Procedures

- Only use sample bottles provided by the analytical laboratory specific for each analysis. Reject any uncapped bottles.
- Ensure bottles remain capped until sample collection and are stored under clean conditions (e.g., in cooler, plastic bag, etc.). Vehicles should also be kept reasonably clean to limit potential contaminant sources.
- Only leave the sample bottle uncapped while rinsing (if rinsing is required), filling the bottle and/or adding preservatives. Do not touch the cap liner or the inside of the sampling bottles (even when wearing gloves). When sampling store caps in a plastic bag.
- Do not rinse bottles that are supplied clean by the laboratory.
- Un-powdered latex, nitrile or polyethylene disposable gloves should be worn while collecting water samples and refrain from smoking or eating. If gloves are not worn, jewelry and watches should be removed. Do not use insect repellent if sampling by hand or be very careful that insect repellent does not come into contact with the samples.
- While sampling avoid submerged vegetation and ensure sample is free of obvious foreign material not representative of the water column at time of sampling (e.g., algae, sediment, organic matter, etc.).

- To collect a grab sample, grasp the bottle well below its neck and lower into the water until it is completely covered. Turn the bottle so that the opening is upstream; keep the hand downstream. Always face upstream to avoid stirring up sediment and sample below the water surface. When not in use, keep all sample collection equipment in sealed clean plastic bags or in a clean cooler.
- If the sample requires any processing, such as filtering or preserving, do that as soon as possible following sample collection. Note that filtering, if required, MUST be done before preserving. If filtering is necessary but cannot be done in the field, then do not add preservative. Have the lab filter and preserve.
- When sampling a stream, sample mid-stream if possible.
- Samples should be collected in a specific order:
  - The first samples collected should be those to be used as blanks.
  - Then the "clean-first" sampling should be done – samples which may be sensitive to contamination, such as bacteriological.
  - If required, collect samples from which field measurements will be taken (if they cannot be done in situ, which is preferable).
  - Collect any remaining samples, including replicates if they are being taken.
- Filled sample bottles should be placed in a cooler with ice packs shortly after collection.
- During warm summer months, shipping coolers should be kept out of the sun and away from other heat sources.
- During cold winter months, it may be necessary to use bladders or jugs of warm water inside of shipping coolers to prevent samples from freezing. Samples should never be allowed to freeze, as this can have significant consequences on analysis of many parameters.

5.0 DEVIATION FROM PROCEDURE

Adherence to this procedure will help to ensure that samples are properly collected and risk of contamination is controlled. Deviation from this procedure may result in improper collection of samples, increased risk of contaminated or compromised samples, and poor data.

6.0 KEY DOCUMENTS/TOOLS/REFERENCES

- Alberta. 2006. Aquatic ecosystems field sampling protocols. Alberta Environment. March.
- British Columbia. 2003. British Columbia field sampling manual for continuous monitoring and the collection of air, air-emission, water, wastewater, soil, sediment and biological samples. Province of British Columbia, Ministry of Water, Land and Air Protection. January.
- CCME. 2011. Protocols manual for water quality sampling in Canada. PN 1461. Canadian Council of Ministers of the Environment.
- Teck. 2012. Environment, Health, Safety and Community Management Standards. July.
    - Standard 4 – Water, Ecosystems and Biodiversity
    - Standard 13 – Monitoring – Measurement, Inspection and Audit
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FIELD FILTRATION

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1.0 PURPOSE

If a sample is to be measured by the laboratory for dissolved analytes, then is must be filtered prior to analysis. This document describes the procedure for filtering samples or for having them filtered.

2.0 RESPONSIBILITIES

Depending on the operation, field monitoring activities and documentation may be carried out by an Environmental Officer, Environmental Technician (not all operations have this position), or a designate, such as an Environmental Co-op Student.

The Environmental Officer, Technician, or designate is responsible for:

- Filtering a sample to be analyzed for dissolved parameters in accordance with this procedure, or
- Informing the analytical laboratory that a sample is to be filtered and then preserved prior to analysis

3.0 BACKGROUND

Some samples for dissolved analytes, including dissolved metals and dissolved carbon, require filtration prior to analysis.

NOTE THAT SAMPLES SHOULD NOT BE PRESERVED BEFORE THEY HAVE BEEN FILTERED. IF A SAMPLE IS TREATED WITH PRESERVATIVE PRIOR TO FILTRATION, IT IS RUINED AND MUST NOT BE ANALYZED FOR.

If a sample for dissolved analytes cannot be filtered, then ship unfiltered and unpreserved and have the laboratory perform the filtration and preservation prior to analysis.

If there are questions regarding whether or not a sample must be filtered, contact an account manager or client services at the laboratory prior to performing any sampling.

4.0 PROCEDURES

Procedure for Field Sample Filtration: Disposable Syringe Filters

Disposable syringe filters are useful for quick filtration where a relatively small volume (< 200 mL) of filtered sample is required. These should be used only if the water has low turbidity as they can clog after a very small volume of sample. It is recommended that a backup supply of high-capacity disposable filters be on hand in case some of the samples cannot be filtered with a syringe filter.

1. Collect a sample in a properly decontaminated container following the procedures the procedures in Field Sampling Manual. (Note: Process all unfiltered samples prior to filtering.) In some cases, samples may be pumped from the source water directly to the filter without a collection container.
2. Remove sample from the container with a new 30- or 60-mL disposable syringe.
3. Attach the syringe to the inlet of a new disposable syringe filter.
4. Pass the water through the filter by applying slow, steady pressure to the syringe, discarding the first draw.
5. Repeat Steps 3 and 4, directing the filtered water into the required sample bottles, until the required volume has been filtered. Pay attention to the pressure required to push the water through the disposable filter. If it becomes difficult to push the sample, the filter is becoming clogged and it should be replaced.
6. After the filtered sample is collected, discard the filter and syringe. Use a new filter at the next sampling location.

Procedure for instances when a sample cannot be filtered in the field:

If a sample cannot be filtered in the field or within a short amount of time after returning to the office, then DO NOT PRESERVE IT. Indicate on the Chain of Custody form that the sample requires filtration and preservation prior to analysis. The laboratory can provide this service at a cost to Teck Coal.

5.0 DEVIATION FROM PROCEDURE

Adherence to this procedure will help to ensure that samples which require filtration prior to analysis are handled properly. Deviance from this procedure may result in a ruined sample which cannot be analyzed or which yields inaccurate results.

6.0 KEY DOCUMENTS/TOOLS/REFERENCES

- British Columbia. 2003. British Columbia Field sampling manual for continuous monitoring and the collection of air, air-emission, water, wastewater, soil, sediment and biological samples. Province of British Columbia, Ministry of Water, Land and Air Protection. January.

- CCME. 2011. Protocols manual for water quality sampling in Canada. PN 1461. Canadian Council of Ministers of the Environment.

- Teck. 2012. Environment, Health, Safety and Community Management Standards. July.

    - Standard 13 – Monitoring – Measurement, Inspection and Audit
    - Standard 20 – Documents and Records

PREPARATION OF FIELD QUALITY CONTROL SAMPLES FOR SURFACE WATER

Teck

Teck Coal Ltd. utilizes a system in which Standard Practices and Procedures are developed, implemented and maintained. This helps ensure that safety and environmental risks associated with various work tasks are identified, mitigated and managed.

1.0 PURPOSE

This SP&P describes the preparation and collection frequency of split and co-located samples, matrix spike/matrix spike duplicates, equipment blanks, filtration blanks bottle blanks, trip blanks, temperature blanks, field blanks, and reference materials (i.e., a standard reference material, a certified reference material, or other reference material; for the purposes of this document the acronym CRM will be used for all types of reference materials) for surface water samples. Not all of the field quality control (QC) samples discussed in this procedure may be required for a given project. The specific field QC samples will be identified in the field sampling manual, project-specific sampling and analysis plan (SAP) and/or quality assurance project plan (QAPP).

This procedure incorporates guidelines from *Protocols Manual for Water Quality Sampling in Canada* (CCME 2011), *British Columbia Field Sampling Manual* (British Columbia 2003), *Aquatic Ecosystems Field Sampling Protocols* (Alberta 2006), and *Guidelines for Quality Assurance and Quality Control in Surface Water Quality Programs in Alberta* (Mitchell 2006).

2.0 RESPONSIBILITIES

Depending on the operation, field monitoring activities and documentation may be carried out by an Environmental Officer, Environmental Technician (not all operations have this position), or a designate, such as an Environmental Co-op Student.

The Environmental Officer, Technician, or designate is responsible for:

- Preparation of quality control samples, or
- Handling of quality control samples if they are provided by the laboratory,
- Shipping of quality control samples to the laboratory
- Management of analytical results from quality control samples

3.0 BACKGROUND

Quality control samples are utilized in order to provide indication that a sampling or analytical process is moving away from proper control. Further, they provide data which can be used to identify and quantify error associated with collection and analysis of samples.

The principle indicators of data quality are its bias and precision, which, when combined, express its accuracy. (SMEWW – 2005).

Bias can be defined as a measure of systematic errors – one component is the method used, and the other is the use of the method by laboratory personnel. It is best measured by laboratory intercomparison studies.

Precision is a measure of the closeness with which multiple analyses of a given sample agree with each other - (SMEWW – 2005). Precision is specified by the standard deviation of sample results. The best way to establish precision is through repeated analysis, replicate samples or by analysis of known additions to samples.

Accuracy is the closeness of a measurement to the true value. A measurement is acceptably accurate when both the systematic and random errors are low.

Teck Coal can assess precision by ensuring that duplicate samples and blanks are taken regularly. Teck Coal influences bias by ensuring that the labs they use maintain suitable accreditation. For those samples that are analyzed with portable meters, Teck Coal ensures that the manufacturers' operating and calibration procedures are strictly followed.

4.0 PROCEDURES

QA SAMPLES:

QA samples should include the following:

- For projects where samples are forwarded to laboratories for analysis, the recommended field QC samples are: an equipment blank, filtration blank, a field duplicate, field blank, trip blanks, and matrix/matrix spike duplicates. See Table 1 for recommended frequencies.
- For field measurements, QC samples depend on the parameter to be measured. These include collection of a check sample during ascent when collecting depth

profiles, verifying dissolved oxygen probe performance with Winkler titration, comparison of multiprobe's temperature reading to that of a thermometer, or measurement of a calibration solution's value at the end of the day. These steps are described in SOP TC-SW-01. (BC Manual indicates that this shall include hysteresis plots when results are collected as vertical profiles; however, CCME indicates that one sample at 1 m while ascending is sufficient).

QC samples, except for matrix/matrix spike duplicates, bottle blank, or temperature blanks, will be sent to the laboratories blind. QC samples will be prepared and labeled in the same manner as regular samples, with each QC sample being assigned a unique sample number that is consistent with the numbering for regular samples. Under no circumstances should the laboratory be allowed to use reference materials, equipment blanks, filtration blanks, or trip blanks for laboratory QC analysis (i.e., laboratory duplicates). To prevent this from happening, regular samples should be selected and marked on the chain-of-custody form.

All field QC samples will be packaged and shipped with other samples in accordance with procedures outlined in SOP TC-GEN-05. Sample custody will be maintained in accordance with procedures outlined in SOP TC-GEN-01.

Field quality control samples will be prepared at predetermined frequencies and at least once per sampling event. If the number of samples taken does not equal an integer multiple of the intervals specified in Table 1, the number of field QC samples is specified by the next higher multiple. For example, if a frequency of 1 QC sample per 20 is indicated and 28 samples are collected, 2 QC samples will be prepared.

Table 1. Field quality control sample requirements for surface water sampling

Quality Control sample Name	Preparation		
	Location	Method	Frequencya
Co-located sample (field replicate)	Sampling site	Additional natural sample	One replicate per 10 samples or sample set.
Split sample	Sampling site	Additional natural sample	One per 10 samples. May not be applicable if co-located sample is being collected.
Matrix spike/ matrix spike duplicate	Sampling site	Additional sample bottles filled for laboratory QC requirements	One per 20 samples.

Quality Control sample Name	Preparation		Frequencya
	Location	Method	
Equipment blank	Sampling site	Analyte free reagent water used for last rinsing.	When carry-over possible. Minimum of one per sample set per type of sampling equipment used and then every fifth site.
Filtration blank	Sampling site	Analyte free reagent water prepared by the laboratory collected, filtered, and preserved identically to a genuine sample.	Minimum of two per sampling event per type of sampling equipment used. Collect at the start and mid-way through sample collection.
Bottle blank	Field	Unopened bottle	Only for reused bottles. One per sample episode or one per bottle type.
Trip blank	Laboratory	Deionized water with preservative	VOCs only. One per each sample cooler shipment.
Temperature blank	Laboratory	Deionized water	One per sample cooler.
Field blank	Sampling site	Open bottle with deionized water, filtered and preserved identically to associated samples.	One per every ten regular samples.
Certified reference material	Field laboratory or sampling site	CRM ampules or other containers for each analyte group	One set per 50 samples, one per episode or beginning of a new project.

a Frequencies provided here are the most stringent from Alberta (2006) or British Columbia (2003).

CO-LOCATED SAMPLES:

Co-located (or field replicate) samples are samples collected in an identical manner over a minimum period of time.

Preparation

1. Collect two completely separate samples from the same station.
2. Label sample with a unique sample ID. Record on datasheet that the sample is a co-located sample, and the sample ID of the first sample.
3. Submit them for analysis as separate samples.
4. Co-located samples will be collected at a minimum frequency of 1 per 10 samples or once per sampling event, whichever is more frequent.

SPLIT SAMPLES:

Split samples are collected to assess the homogeneity of the samples collected in the field and the precision of the sampling process.

Preparation:

1. Collect two aliquots for the sample from a single sample collection (split from a composite bucket or using a churn-splitter). Care must be taken to ensure that the samples are split in in a manner that ensures homogeneity.
2. Label sample with a unique sample ID. Record on datasheet that the sample is a split sample, and the sample ID of the first sample.
3. Submit them for analysis as separate samples.
4. Split samples will be collected at a minimum frequency of 1 per 10 samples or once per sampling event, whichever is more frequent.
5. If co-located samples are collected, collection of split samples is not necessary.

MATRIX SPIKE/MATRIX SPIKE DUPLICATES:

The matrix spike/matrix spike duplicate (MS/MSD) analyses provide information about the effect of the sample matrix on the design and measurement methodology used by the laboratory. (Note: Not included in BC Manual; however, these samples are recommended).

Preparation:

1. Extra sample volumes may be required to be collected from designated surface water stations (use a bigger sample bottle or collect an additional sample from the same location).
2. Indicate on sample label and chain-of-custody form that this sample should be used for preparing MS/MSD.
3. Submit sample with larger volume for analysis as a single sample.
4. MS/MSDs are collected at a minimum frequency of 1 per 20 samples or once per sampling event, whichever is more frequent.

EQUIPMENT BLANK:

Equipment blanks are samples of de-ionized water that have been used to rinse sampling equipment that will come into direct contact with water samples. An equipment blank is collected after completion of the decontamination process (washing) and prior to sampling.

Preparation:

- Pour the rinse (de-ionized) water used for the last rinsing into a pre-labeled bottle that identifies the piece of equipment cleaned.
- Label with a unique sample ID. Record on datasheet that this corresponds to the equipment blank.
- Submit sample for analysis.
- Equipment blanks are prepared when carry-over between sample locations is possible. Collect 1 equipment blank for every 5 sample locations for each type of equipment used.

FILTRATION BLANKS:

Filtration blanks are de-ionized water that is passed through the filtration apparatus in the same manner as the sample. Analysis of the filtrate provides an indication of the types of contaminants that may have been introduced through contact with the filtration apparatus. Filtration blanks are also used as a check for potential cross-contamination through inadequate field cleaning techniques (rinsing of the apparatus with de-ionized water between samples).

Preparation:

1. Filter the sample according to the protocol in SOP TC-SW-03.
2. Add preservative in the same fashion as the associated samples.
3. Label with a unique sample ID. Record on datasheet that this corresponds to the filtration blank.
4. Submit sample for analysis.
5. Collect filtration blank both at the start and again at some point between samples (after the apparatus has been cleaned and immediately before the next "real" sample is filtered).

BOTTLE BLANKS:

The bottle blank is an unopened sample bottle. Bottle blanks are submitted along with surface water samples to ensure that contaminants are not originating from the bottles themselves because of improper preparation, handling, or cleaning techniques. As needed, one bottle blank per lot of prepared bottles will be submitted for analysis. If more than one type of bottle will be used in the sampling (e.g., HDPE or glass), then a bottle blank should be submitted for each type of bottle and preservative. Bottle blanks are collected if bottles are reused.

Preparation:

1. Set aside one unopened sample bottle from each bottle lot.
2. Label bottle as "Bottle Blank" on the label, the datasheet, and the chain-of-custody form.
3. Submit the empty bottle for analysis.
4. Collect filtration blank both at the start and again at some point between samples (after the apparatus has been cleaned and immediately before the next "real" sample is filtered).

TRIP BLANKS:

Trip blanks will be used to help identify whether contaminants may have been introduced during the shipment of the surface water samples from the field to the laboratory. Trip blanks are prepared at the testing laboratory by pouring analyte free reagent water into bottles and tightly closing the lids. Preservative is added if field samples require preservation. Trip blanks are

collected only if volatile compounds are analyzed from samples. (Note: BC field manual indicates trip blanks should be collected always, while Alberta guidance indicates trip blank is for volatiles only. I recommend following the Alberta guidance).

Preparation:

1. Transport trip blank unopened to and from the field in the cooler.
2. Label bottle with a unique ID. Record on datasheet that this sample is the trip blank.
3. Place inside the cooler that contains newly collected samples. Trip blank will remain in the cooler at all times.
4. Submit the trip blank for analysis.
5. One trip blank will be sent with each cooler of samples shipped to the testing laboratory.

FIELD BLANK:

Field blanks mimic the extra sampling and preservative process but do not come in contact with ambient water. Field blanks are exposed to the sampling environment at the sample site and they provide information on contamination resulting from the handling technique and through exposure to the atmosphere. Field blanks are processed in the same manner as the associated samples (i.e., they are exposed to all the same potential sources of contamination as the sample), including handling, filtration, and/or preservation.

Preparation:

1. Open the field blank bottle prepared by the laboratory to expose the deionized water to the air for as long as the sample was exposed when it was collected.
2. Filter the field blank and add preservative only if the associated sample requires filtration and preservation.
3. Label with a unique sample ID and record on the datasheet that this sample is the field blank.
4. Submit the field blank for analysis.
5. Collect one field blank for every ten regular samples.

TEMPERATURE BLANKS:

Temperature blanks will be used by the laboratory to verify the temperature of the samples upon receipt at the testing laboratory. Temperature blanks will be prepared at the testing laboratory by pouring distilled/deionized water into a vial and tightly closing the lid.

Preparation:

1. Add the unopened temperature blank to cooler with samples.
2. Label with "Temperature Blank" and record on chain-of-custody form. Make sure no analyses other than temperature are requested.
3. Submit the temperature blank along with other samples to the laboratory.
4. One temperature blank is included with each sample cooler shipped to the laboratory.

REFERENCE MATERIALS:

Reference materials (i.e., a standard reference material, a certified reference material, or other reference material) are samples containing known analytes at known concentrations. It is obtained from a recognized national scientific body such as the National Research Council. The CRMs have undergone multilaboratory analyses using a standard method which provides certified concentrations. When available for a specific analyte, CRM samples provide a measure of analytical performance and/or analytical method bias (i.e., accuracy) of the laboratory. Several CRMs may be required to cover all analytical parameters. (Note: I have provided instructions for whole-volume reference material, which does not require dilution in the field.)

Preparation:

Whole-volume reference materials are samples that have predetermined concentrations and require no dilution before being sent to the laboratory. The following steps will be taken to prepare the reference materials:

1. Read the instructions provided with the reference materials carefully, including the Material Safety Data Sheet. Also, note any information that may relate to the holding time for the reference materials.

2. Remove the reference material container from its packaging, and check for any inconsistencies between the identification information given on the container and the instructions. Record the identification number and lot number, if available, in addition to any discrepancies on the datasheet.
3. Shake the container well to mix the sample and remove any condensation from the sides of the container.
4. Pour the contents of the container (or containers, if more volume is required than is provided with a single reference material) directly into a sample bottle. Make sure the sample bottle is appropriate for the analytes of interest. Avoid contacting the lip of the reference material bottle with the sample container because it is a possible source of external contamination. Cap the bottle after it has been filled.
5. Label the sample with a unique ID. Record on datasheet that this is a reference material.
6. Submit sample for analysis.
7. Date and store all records of the reference material, including the container used.
8. Consult with the project QA/QC coordinator regarding saving unused reference material concentrate for future use. Some reference materials can be stored in a new container for up to several months.
9. Prepare one reference material sample set per 50 samples, one set per episode, or at the beginning of a new project.

5.0 DEVIATION FROM PROCEDURE

Adherence to this procedure will allow for the collection of suitable QA/QC samples which can be used to identify and quantify error with sampling processes or the analytical process, and will provide improved confidence in monitoring and sampling data. Deviation from this procedure could allow systemic error to remain undetected, which can lead to reduced confidence in the greater data set of analytical results from monitoring and sampling programs.

6.0 KEY DOCUMENTS/TOOLS/REFERENCES

- Alberta. 2006. Aquatic ecosystems field sampling protocols. Alberta Environment. March.
- British Columbia. 2003. British Columbia Field sampling manual for continuous monitoring and the collection of air, air-emission, water, wastewater, soil, sediment and biological samples. Province of British Columbia, Ministry of Water, Land and Air Protection. January.
- Mitchell, P. 2006. Guidelines for quality assurance and quality control in surface water quality programs in Alberta. Alberta Environment. July.
- Teck. 2012. Environment, Health, Safety and Community Management Standards. July.
    - Standard 13 – Monitoring – Measurement, Inspection and Audit

SAMPLING FOR BIOASSAYS AND TOXICITY TESTING

Teck

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1.0 PURPOSE AND SCOPE

This document outlines the procedure which will be used by environment personnel for sampling surface water to be used for bioassays or toxicity testing utilizing *Oncorhynchus* mykiss (rainbow trout) and/or *Daphnia magna*.

2.0 RESPONSIBILITIES

Depending on the operation, field monitoring activities and documentation may be carried out by an Environmental Officer, Environmental Technician, or a designate, such as an Environmental Co-op Student.

The Environmental Officer, Technician, or designate is responsible for:

- Communicating with the laboratories to ensure necessary supplies are available and that the lab anticipates receiving the samples
- Collecting, packaging and shipping samples of water to be used for bioassays or toxicity testing
- Immediately communicating any concerns regarding sample results with their supervisor

3.0 BACKGROUND

The requirement to perform periodic analysis of mine effluent water is a relatively new regulatory requirement for some Teck Coal operations, and it is expected that all operations will soon be required to do it. In addition to regulatory compliance, an operation may want to perform bioassays or toxicity testing for other reasons, such as when considering new water treatment chemicals such as flocculants. These tests are typically performed using rainbow trout and *Daphnia magna.*

When having a bioassay performed, ensure that it is known and clearly indicated whether a single concentration test with full strength effluent is to be performed, or whether a multi-concentration test is required to determine the median lethal concentration (LC50).

Because these tests utilize living organisms, and despite efforts to ensure that testing is strongly controlled, there are potentially issues with the nature of this type of test. Particularly for those operations who are required to test by regulatory requirements, it is imperative that Teck Coal environmental personnel take proper precautions and strictly adhere to sampling procedures. This SP&P has been written to be in strict agreement with Environment Canada's documents which detail sampling and analysis procedures. Further, there is potential regulatory risk to Teck Coal if analytical results are non-compliant with regulatory limits.

In order to be diligent and as protected as possible against undesired results which may be artifacts of the analysis process itself or chain of custody issues, it is strongly recommended that:

- Samples are properly packaged and shipped to the laboratory as quickly as possible following collection. The most direct shipping route possible is recommended, even to the point of arranging hot-shot delivery, as any delay may compromise sample integrity and lead to undesired results.

- Every instance of sampling should include two sets of samples, where sets are simultaneously collected and sent to two different laboratories for analysis.

It is strongly recommended that Teck Coal environment personnel who will be performing this sampling review and become familiar with the Environment Canada reference documents which are cited at the end of this SP&P.

4.0 PROCEDURES

1. Communicate with the laboratory(ies) prior to sampling to ensure that:

    a. proper supplies are available (high volume capacity containers are required)

    b. sufficient water sample volumes will be provided (large sample volumes are required)

c. the proper test is going to be run (either single concentration or multi-concentration)

d. receipt of the samples is expected so that they can be properly handled and/or the tests can be set up immediately

e. if a flocculant or water treatment product is going to be tested for toxicity, the volume/mass required by the lab

2. Containers used for sampling must be nontoxic (eg. polyethylene or polypropylene carboys or pails) and must either be new or thoroughly cleaned and dried. Preferably, they should be provided by the laboratory.

3. Collect the sample in accordance with surface water sampling procedures (SP&P TC-SW-02). The sample containers should be completely filled to exclude any air. After the container has been filled, ensure the lid is secure and sealed.

4. Collect two sets of samples at each location, either simultaneously or one set immediately after the other. Each set will be sent to a separate laboratory for analysis.

5. This sampling should be conducted along with any additional sampling for water chemistry (detailed or routine as required by regulatory requirements) so that data is available from the same date and time. In addition, water monitoring should be conducted for:

   a. Temperature

   b. Turbidity

   c. pH

   d. Dissolved oxygen

   e. Conductivity

   f. Flow rate (ie. of pond effluent, if a discharging settling pond is being sampled)

   g. Photographs

6. Relevant inspections and note of related activities should be conducted and documented. This should include but is not limited to the status of the settling pond, pumping activities in the area, and status of any flocculant station or other water treatment activities.

7. Samples should be kept in the dark and cool (ideally between 1 and 8°C) but must not be allowed to freeze.

8. If also providing a sample of a water treatment product (eg. flocculant), provide the required volume/mass (as discussed with the lab) in a laboratory-supplied sample container. Ensure the container is completely labeled including a WHMIS label. Supply a copy of the current Material Safety Data Sheet (MSDS) along with the product.

9. Package and ship the samples as quickly as possible following collection. Testing of samples should commence as quickly as possible following collection. The test should begin within three days AND MUST COMMENCE NO LATER THAN FIVE DAYS AFTER SAMPLING.

5.0 DEVIATION FROM PROCEDURE

Adherence to this procedure will help to ensure that sampling potable water for bacteriological analysis is conducted in a manner which prevents sample contamination and provides meaningful results. Deviation from this procedure may result in sample contamination which could provide false positive results.

6.0 KEY DOCUMENTS/TOOLS/REFERENCES

- Alberta. 2006. Aquatic ecosystems field sampling protocols. Alberta Environment. March.

- British Columbia. 2003. British Columbia field sampling manual for continuous monitoring and the collection of air, air-emission, water, wastewater, soil, sediment and biological samples. Province of British Columbia, Ministry of Water, Land and Air Protection. January.

- CCME. 2011. Protocols manual for water quality sampling in Canada. PN 1461. Canadian Council of Ministers of the Environment.

- Environment Canada/ 2000. Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to *Daphnia magna.* EPS 1/RM/14 Second Edition. December (with May 2007 amendments).

- Environment Canada/ 2000. Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout. EPS 1/RM/13 Second Edition. December.
- Teck. 2012. Environment, Health, Safety and Community Management Standards. July.
    - Standard 4 – Water, Ecosystems and Biodiversity
    - Standard 13 – Monitoring – Measurement, Inspection and Audit
    - Standard 20 – Documents and Records